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about the head. In most cases it is shown as a bright central portion four or five minutes in diameter and usually circular, surrounded by a fainter nebulous portion from ten to fifteen minutes in diameter and often elliptical. In the cases where this nebulous portion was elliptical the major axis was not always coincident or parallel with the axis of the tail.

On June 5th the negatives taken with each instrument show the nucleus as a small bright dot less than one minute in diameter. On this date there seems to have been no nebulosity about the head, although it was twelve minutes in diameter. In the reproduction it appears sharper than on other dates. Unfortunately, the nucleus has disappeared in the process of reproduction.

PHYSICAL CHANGES OBSERVED IN THE HEAD OF SWIFT'S COMET.

By C. D. Perrine.

After passing perihelion, Swift's comet (1899 *a*) showed evidences of considerable internal action. Before perihelion it was simply a round mass of nebulosity, increasing in brightness towards the center, but with only a faint nucleus and little or no tail. The comet was then barely visible to the naked eye under good conditions. It again became visible in the latter part of April, after having been lost in the Sun's rays for nearly a month. It was then much changed in appearance, being much brighter and easily visible to the unaided eye. The nucleus had become much condensed and much brighter — resembling a star of 6½ or 7th magnitude, with low magnifying powers. It also had a tail several degrees in length. It was first observed with the 36-inch refractor on the morning of May 7th, with a magnifying power of 270. The seeing was not good, the star-images being considerably blurred.

The following notes were made at the time: "No structure to be detected in the coma. The nucleus is sharp and under the atmospheric conditions existing does not differ from a star. Nucleus fully 7th magnitude, possibly brighter. North preceding the nucleus there is a small appendage brighter than the surrounding coma — about 10″ in length and half as wide. The head of the comet fills the entire field (6′ in diameter)."

The comet was observed again the following night, the appearance being the same.

It was next examined with the large refractor on May 11th, when a second nucleus was distinctly visible. This second nucleus was much fainter than the principal one — being estimated at 9.5 magnitude, while the principal nucleus was estimated at 8.0 magnitude. The conditions were better at the time of this observation, and it was seen that neither nucleus was quite stellar, even with low powers.

Following are the measures of position-angle and distance of the fainter nucleus referred to the brighter:—

Greenwich M. T.			Magnitudes.	
1899, May 11.99	263°.5	12″.5	8.0	9.5
12.96	261 .0	14 .3	8.0	9.5
13.98	260 .0	16 .5		
14.96	256 .6	18 .2	8.0	10.0
18.96	246 .4	25 .2	9.0	11.0
19.97	243 .4	26 .5	9.5	11.0
20.98	241 .0	29 .4	9.5	11.5

The comet was again examined on May 26th, but under poor conditions, there being a nearly full moon and rather poor seeing. Following are my observing notes: "Whole comet is very much fainter. Nucleus is sharp and of 10 or 10½ magnitude. Cannot be certain of the second nucleus."

The comet was next observed on June 3d, when the nucleus was of the 9.0 magnitude and very sharp, having brightened up very much in the interval. The second nucleus was not seen, but a slight brightening in the head about 1′ south of the nucleus was suspected.

On June 4th, the nucleus was stellar and of 8.5 magnitude. Surrounding the nucleus was a bright condensation similar to that of May 6th, which was elongated south. This feature was better seen with a power of 520. With the higher power, the principal nucleus resembled a disc 1″ in diameter. A set of measures at $21^{h}\ 57^{m}$, Greenwich mean time, gave 178°.0 and 23″.4.

On June 6th, 7th, and 8th, this appendage was measured with the 12-inch equatorial, using a power of 150 with the following results:—

June 6.93	170°.8	12″.4	10	and 12
7.91	163 .1	12 .1	10½	13
8.92	155 .6	16 .2	10½	13

On June 8th, the secondary condensation was very faint, and in consequence the settings are somewhat uncertain. The following measure was made with the 36-inch refractor:—

June 9.89 149°.0 16″.9

On this date it was noted as "an extension of (brighter) nebulosity from the nucleus rather than a separate condensation."

On June 26th, the comet had become very faint, the entire comet not brighter than 10th magnitude. The nucleus was estimated at 12–13th magnitude.

From the above observations, it is evident that the nucleus of the comet brightened up materially prior to June 4th, when an elongation of the brighter nebulosity surrounding it took place, and that after this secondary condensation was formed the nucleus rapidly faded. It is probable that the general course was much the same in the first case of the formation of a secondary nucleus, about May 6th. I have no observations bearing on the case prior to that date; but my subsequent observations show clearly the rapid loss of light after the separation of the two nucleii. It seems reasonable to suppose that there was some physical connection between the brightening of the nucleus and the appearance of the two separate condensations.

LICK OBSERVATORY, UNIVERSITY OF CALIFORNIA, July 25, 1899.

OBSERVATIONS OF SWIFT'S COMET (1899 *a*) FOR REFRACTION.

By C. D. PERRINE.

Observations were made on May 18th and June 9th with the 36-inch refractor, to detect if possible any refractive effect on the light of a star passing through the cometary matter. On each date two stars were selected in advance of the comet, so that the nucleus would pass between them. The stars were so chosen that the light from both would have to traverse the cometary matter on opposite sides of the nucleus. In this way any effect of refraction on one star would be *added* to a similar effect on the other star. The distance between the stars was measured before, during, and after the transit of the comet.

Following are the results of the measures after having been corrected for differential refraction:—